

Matrox Odyssey Xpro

Camera Interface Application Note

BASLER spL8192-39kc

December 3, 2010

Basics about the camera	Camera Descriptions ▪ Effective resolution: up to 8192 pixels/line @ 39k lines per second. ▪ Camera Link FULL interface (2 to 8 taps, and 8/10/12-bits). ▪ Sensor: Linear CMOS with Bayer Color Filter¹. ▪ Color RGB or RAW camera modes. ▪ External and Internal sync. ▪ Internal or external exposure control. ▪ 40 or 80 MHz pixel clock rate.
Mode of operations as per Matrox Imaging (in parentheses as per camera manufacturer)	Interface Mode ▪ Fixed line scan rate² ▪ Variable line scan rate³ ▪ Variable line scan rate using the Rotary Encoder³ ▪ Fixed line scan rate with frame trigger² ▪ Variable line scan rate with frame trigger³ ▪ Variable line scan rate using the Rotary Encoder with frame trigger³ ▪ Fixed line scan rate with variable frame size² ▪ Variable line scan rate with variable frame size³ ▪ Variable line scan rate using the Rotary Encoder with frame trigger³ ▪ Fixed line scan rate with area (AOI) mode² ▪ Variable line scan rate with area (AOI) mode³ ▪ Variable line scan rate using the Rotary Encoder with area (AOI) mode³
Basics about the interface modes	Camera Interface Briefs <i>Mode 1: Fixed line scan rate</i> ▪ Up to 8192 pixels/line. ▪ Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps). ▪ DCF configured for 1000 lines per virtual frame. ▪ Matrox Odyssey Xpro sending periodic EXPOSURE1 (EXSYNC) signal to camera. ▪ Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera. ▪ DCF used: spL8192_39kc_8192_12bit2tapsRawColorFLS.DCF 1. Note that the Bayer DCFs ("...RAWColor...") may not display the colors correctly within Matrox Intellicam, however they will work properly in the MIL examples or your MIL-based application. 2. EXSYNC, level-controlled or Free Run programmable 3. EXSYNC, level-controlled

Note that an update (M800EF42 or M900EF03) is required in order to use the Bayer (...RAWColor...) modes. Refer to the DCF's Comments section or contact Technical Support for more information. For enhanced RAW DCFs, contact Matrox Imaging at techmark.imaging@matrox.com

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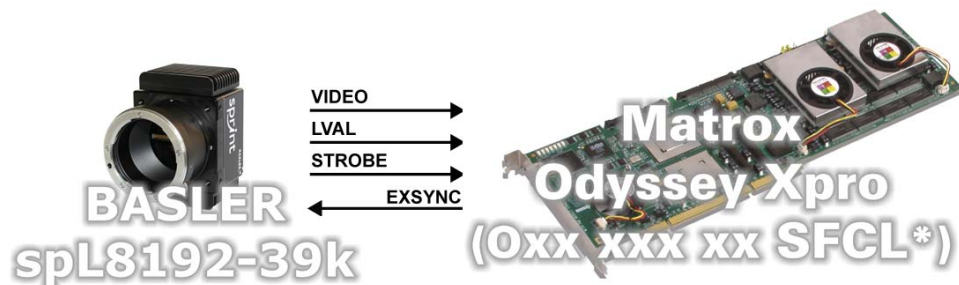
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Basics about the interface modes

Camera Interface Briefs (cont.)

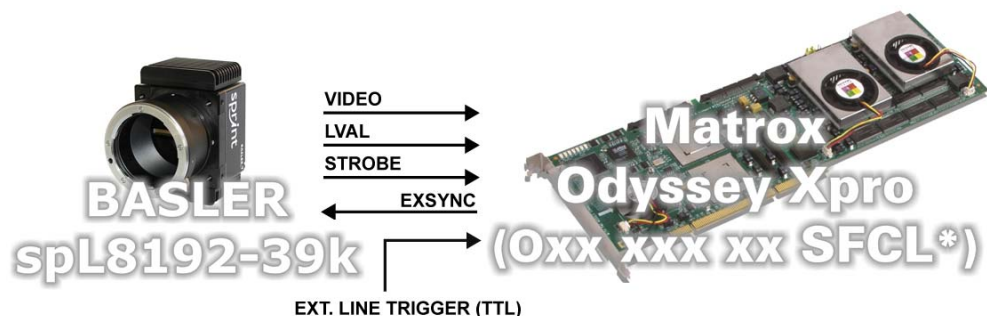
Mode 1: Fixed line scan rate

- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorFLS.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorFLS.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBFLS.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBFLS.DCF](#)



Mode 2: Variable line scan rate

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL line trigger signal.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLS.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLS.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLS.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBVLS.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBVLS.DCF](#)



*Matrox Odyssey Xpro main board with the single-FULL Camera Link frame grabber module

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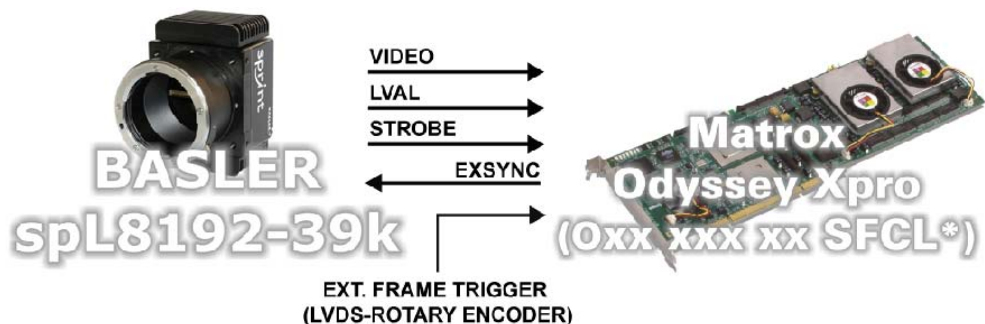
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Basics about the interface modes

Camera Interface Briefs (cont.)

Mode 3: Variable line scan rate with rotary encoder

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external LVDS (Rotary Encoder) line trigger signal.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLSRE.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLSRE.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLSRE.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBVLSRE.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBVLSRE.DCF](#)



Mode 4: Fixed line scan rate with frame trigger

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL frame (virtual) trigger signal.
- Matrox Odyssey Xpro sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL8192_39kc_8192_12bit2tapsRawColorFLSFT.DCF](#)
- DCF used: [SpL8192_39kc_8192_12bit4tapsRawColorFLSFT.DCF](#)

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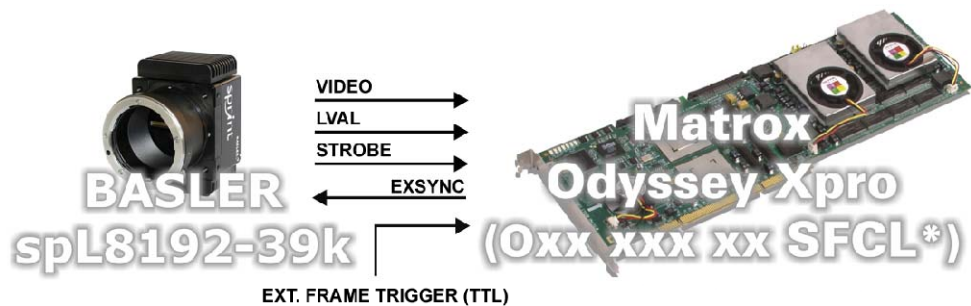
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Basics about the interface modes

Camera Interface Briefs (cont.)

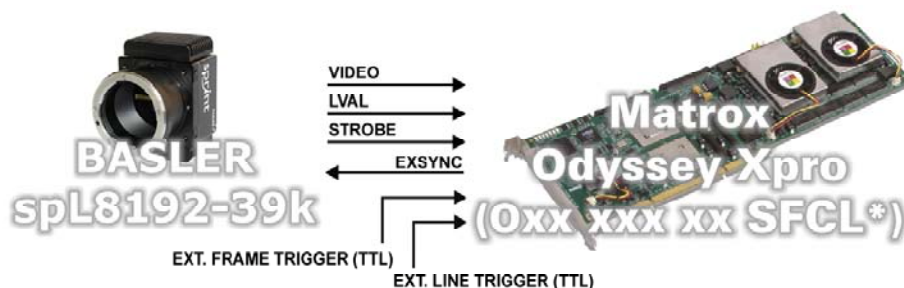
Mode 4: Fixed line scan rate with frame trigger

- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorFLSFT.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBFLSFT.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBFLSFT.DCF](#)



Mode 5: Variable line scan rate with frame trigger

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL frame (virtual) and line trigger signals.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLSFT.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLSFT.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLSFT.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBVLSFT.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBVLSFT.DCF](#)



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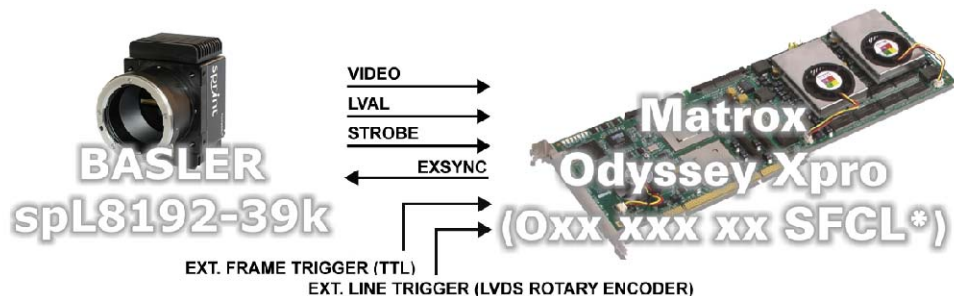
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Basics about the interface modes

Camera Interface Briefs (cont.)

Mode 6: Variable line scan rate with rotary encoder and frame trigger

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL frame (virtual) and LVDS (Rotary Encoder) line trigger signals.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLSFTRE.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLSFTRE.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLSFTRE.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBVLSFTRE.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBVLSFTRE.DCF](#)



Mode 7: Fixed line scan rate with variable frame size

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL frame (virtual) trigger signal.
- Matrox Odyssey Xpro sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.

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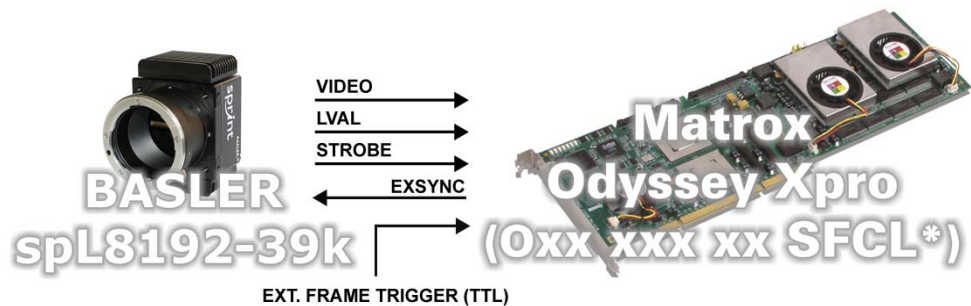
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Basics about the interface modes

Camera Interface Briefs (cont.)

Mode 7: Fixed line scan rate with variable frame size

- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorFLSVF.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorFLSVF.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorFLSVF.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBFLSVF.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBFLSVF.DCF](#)



Mode 8: Variable line scan rate with variable frame size

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL frame (virtual) and line trigger signals.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLSVF.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLSVF.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLSVF.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBVLSVF.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBVLSVF.DCF](#)

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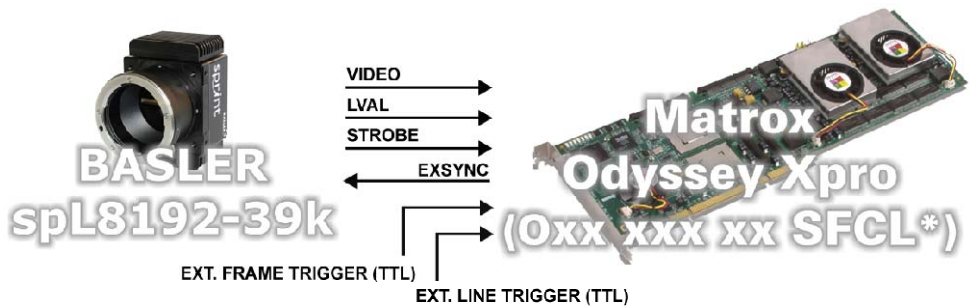
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Basics about the interface modes

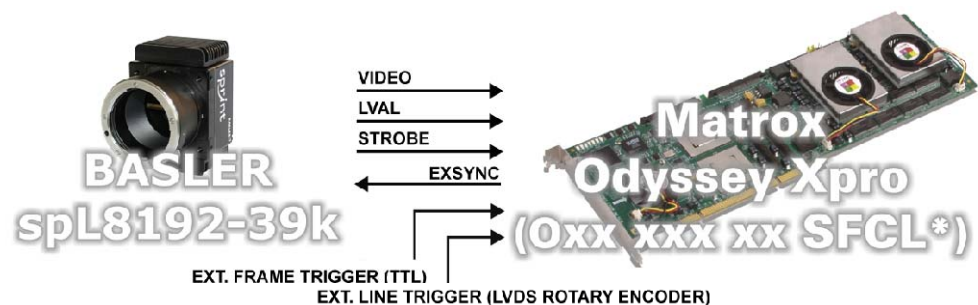
Camera Interface Briefs (cont.)

Mode 8: Variable line scan rate with variable frame size



Mode 9: Variable line scan rate with rotary encoder and variable frame size

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL frame (virtual) and LVDS (Rotary Encoder) line trigger signals.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLSVFRE.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLSVFRE.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLSVFRE.DCF](#)
- DCF used: [spL8192_39kc_4096_10bitRGBVLSVFRE.DCF](#)
- DCF used: [spL8192_39kc_4096_8bit2tapsRGBVLSVFRE.DCF](#)



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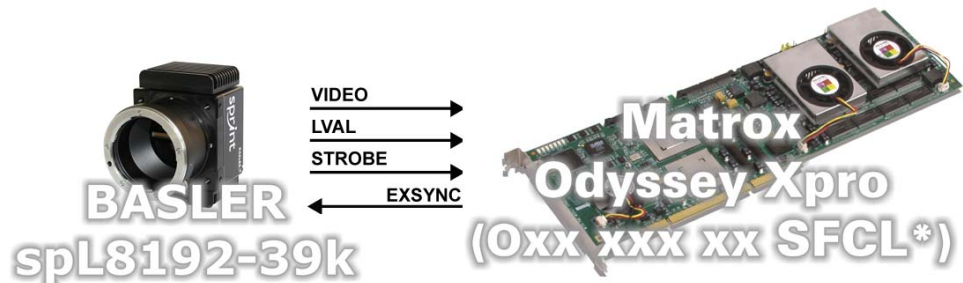
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Basics about the interface modes

Camera Interface Briefs (cont.)

Mode 10: Fixed line scan rate with area (AOI) mode

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving FVAL, LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorFLS_AREA.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorFLS_AREA.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorFLS_AREA.DCF](#)



Mode 11: Variable line scan rate with area (AOI) mode

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external TTL line trigger signals.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving FVAL, LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLS_AREA.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLS_AREA.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLS_AREA.DCF](#)

*Matrox Odyssey Xpro main board with the single-FULL Camera Link frame grabber module

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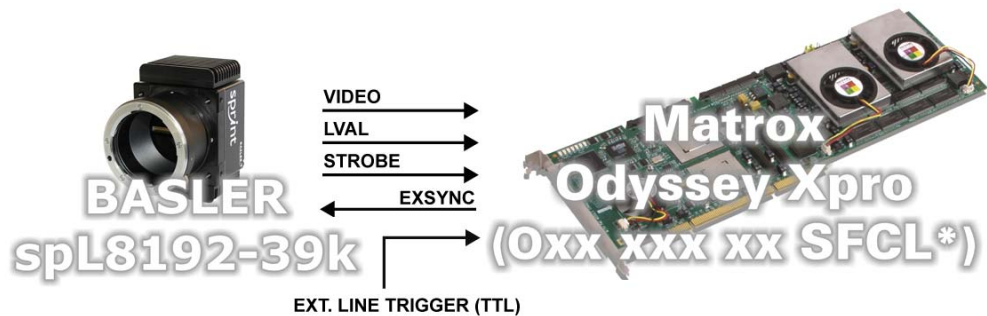
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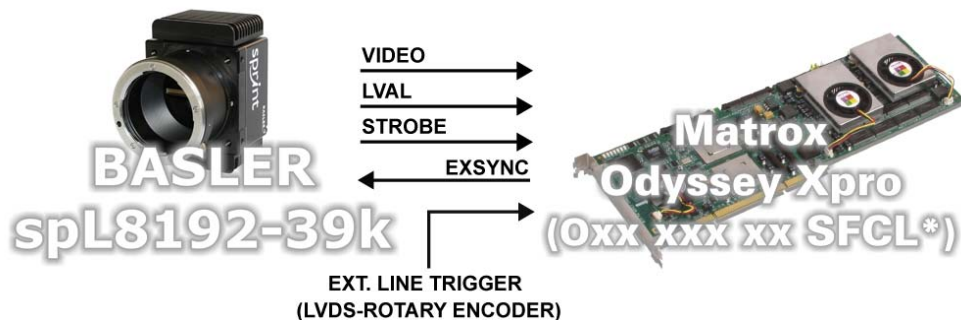
Camera Interface Briefs (cont.)

Mode 11: Variable line scan rate with area (AOI) mode



Mode 12: Variable line scan rate with rotary encoder and area (AOI) mode

- Up to 8192 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Odyssey Xpro receiving external LVDS (Rotary Encoder) line trigger signal.
- Matrox Odyssey Xpro sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Odyssey Xpro receiving FVAL, LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [spL8192_39kc_8192_12bit2tapsRawColorVLSRE_AREA.DCF](#)
- DCF used: [spL8192_39kc_8192_12bit4tapsRawColorVLSRE_AREA.DCF](#)
- DCF used: [spL8192_39kc_8192_8bit8tapsRawColorVLSRE_AREA.DCF](#)



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Specifics about the interface modes

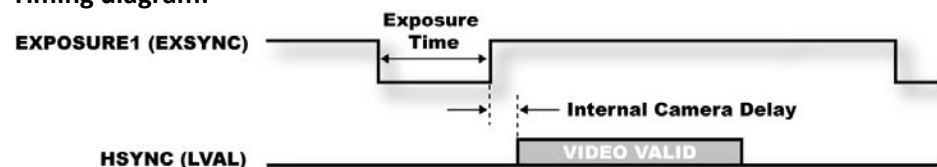
Camera Interface Details

Mode 1: Fixed line scan rate

- **Line rate:** The frequency of the periodic EXPOSURE1 (EXSYNC) signal determines the camera's line rate. The maximum line rate for this camera equals 39 kHz.
- **Exposure time:** For EXSYNC, level-controlled mode the exposure time is the inactive (low level) period between the falling and rising edges of the EXPOSURE1 (EXSYNC) signal. The default exposure time for the DCF (i.e., "eight 8-bit taps" mode) is 14 μ s. Maximum/minimum exposure time per line for this DCF is 210 ms and 12.5 ns respectively. The exposure time can be modified in the DCF using Matrox Intellicam, ONL imCamControl() or imDigControl() function, or with the MIL MdigControl() function. Consult the respective manual for more information.
- **Camera communication:** This DCF will work with all Free Run and EXSYNC modes however EXSYNC, Level controlled is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits or 6 taps RGB, 8-bits, or 3 tap RGB, 10-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First or RGB
Exposure Time Control Mode	EXSYNC or Free Run

- **Bayer Color Filter:** Color information (for the "...RawColor..." DCFs only) is generated by a Bayer color mosaic filter mounted on the sensor. Refer to the MIL online Help for information on using buffers with the Bayer color filter.
- **Timing diagram:**



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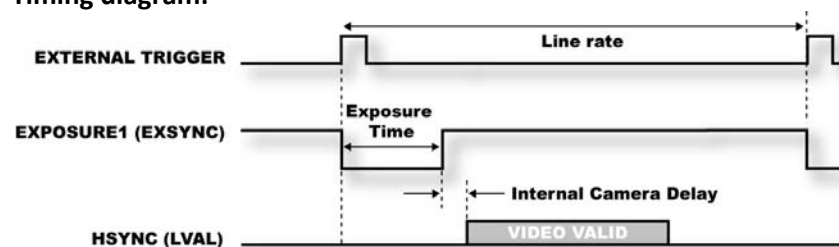
Camera Interface Details (cont.)

Mode 2: Variable line scan rate

- **Line rate:** The line rate is controlled by the frequency of the external TTL line trigger signal. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF “eight 8-bit taps” mode) or slower than the maximum line rate of the camera.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** This DCF works with all EXSYNC modes however EXSYNC, Level-controlled is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits or 6 taps RGB, 8-bits, or 3 tap RGB, 10-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First or RGB
Exposure Time Control Mode	EXSYNC, Level-controlled

- **Bayer Color Filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 3: Variable line scan rate with rotary encoder

- **Line rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF “eight 8-bit taps” mode) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder.

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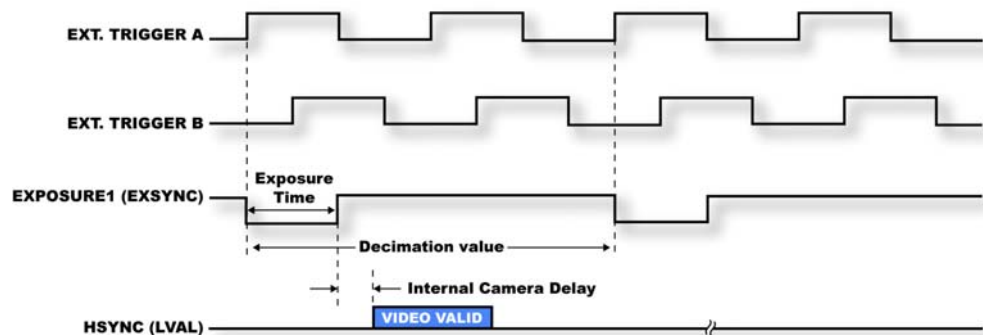
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 3: Variable line scan rate with rotary encoder

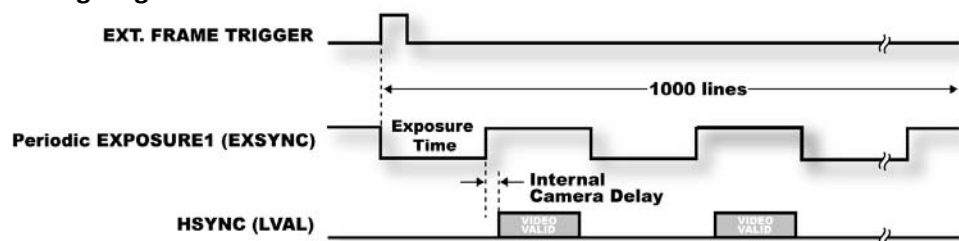
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value showed in this timing diagram is eight (8).

Mode 4: Fixed line scan rate with frame trigger

- **Line/frame rate:** The line rate is fixed and controlled by the frequency of EXPOSURE1 (EXSYNC) signal. The default exposure time for the DCF (i.e., "eight 8-bit taps" mode) is 14 μ s. The virtual frame rate is variable and controlled by the period of the external frame trigger signal, however the external frame trigger period must always be greater than the total time of the number of lines captured. The number of lines per virtual frame (maximum of 1000 for this DCF) is fixed and controlled by the vertical timing of the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 1: Fixed line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



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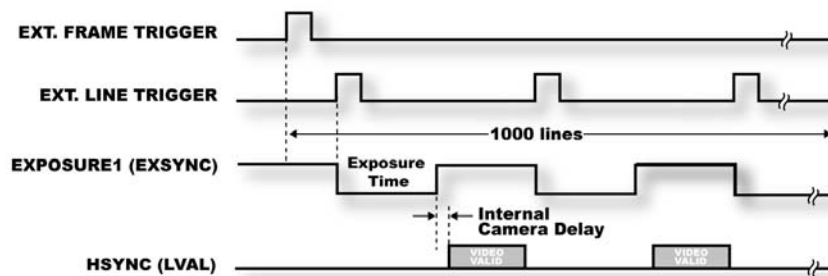
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 5: Variable line scan rate with frame trigger

- **Line/frame rate:** The line rate is controlled by the frequency of the external TTL line trigger signal. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF “eight 8-bit taps” mode) or slower than the maximum line rate of the camera. The default exposure time for this DCF (i.e., “eight 8-bit taps” mode) is $14 \mu\text{s}$. The virtual frame rate is variable and controlled by the period of the external frame trigger signal, however the external trigger period must always be greater than the total time of the number of lines captured. The number of lines per virtual frame (1000 for this DCF) is fixed and controlled by the vertical timing of the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 6: Variable line scan rate with rotary encoder and frame trigger

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF “eight 8-bit taps” mode) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Odyssey Xpro captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.

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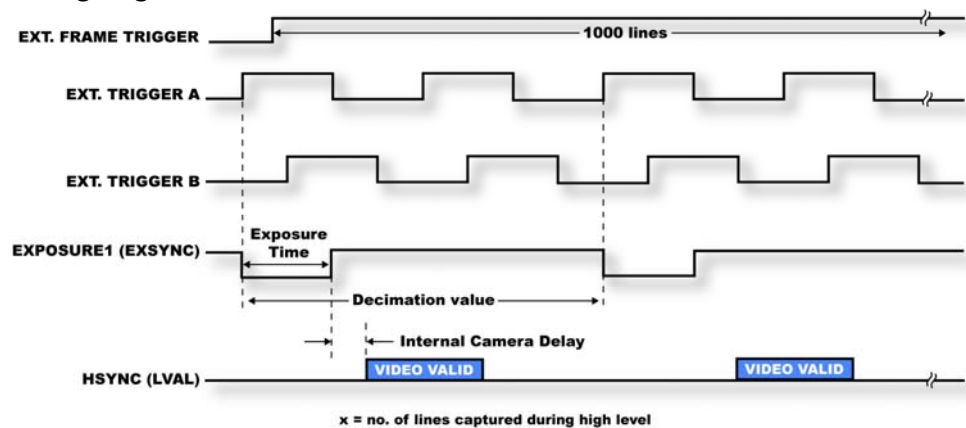
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 6: Variable line scan rate with rotary encoder and frame trigger

- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value showed in this timing diagram is eight (8).

Mode 7: Fixed line scan rate with variable frame size

- **Line/frame rate:** The line rate is fixed and controlled by the frequency of EXPOSURE1 (EXSYNC) signal. The default exposure time for the DCF (i.e., "eight 8-bit taps" mode) is 14 μ s. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Odyssey Xpro captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 1: Fixed line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.

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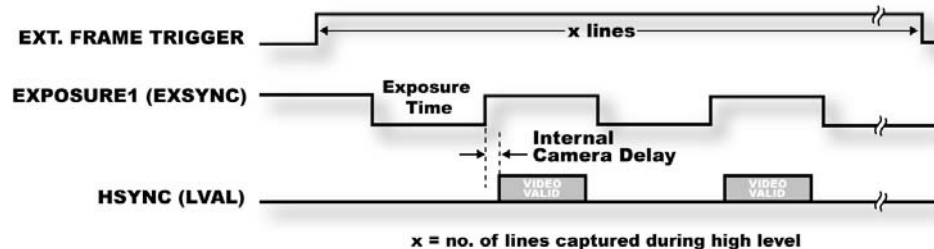
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Specifics about the interface modes

Camera Interface Details (cont.)

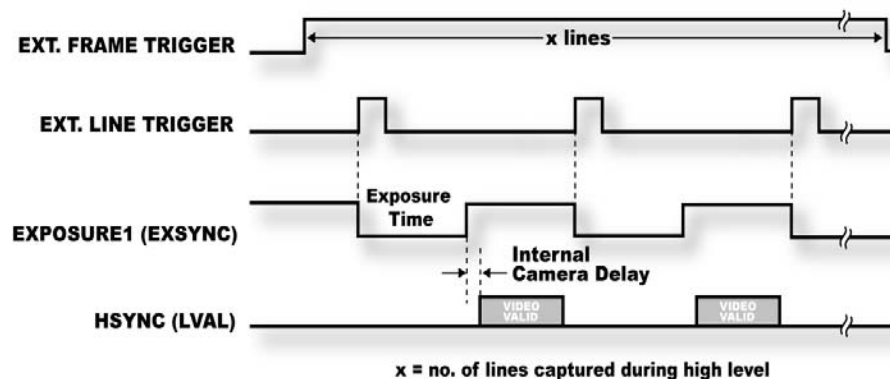
Mode 7: Fixed line scan rate with variable frame size

- **Timing diagram:**



Mode 8: Variable line scan rate with variable frame size

- **Line/frame rate:** The line rate is variable and controlled by the external line trigger frequency. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF "eight 8-bit taps" mode) or slower than the maximum line rate of the camera. The default exposure time for the DCF (i.e., "eight 8-bit taps" mode) is $14 \mu\text{s}$. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Odyssey Xpro captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



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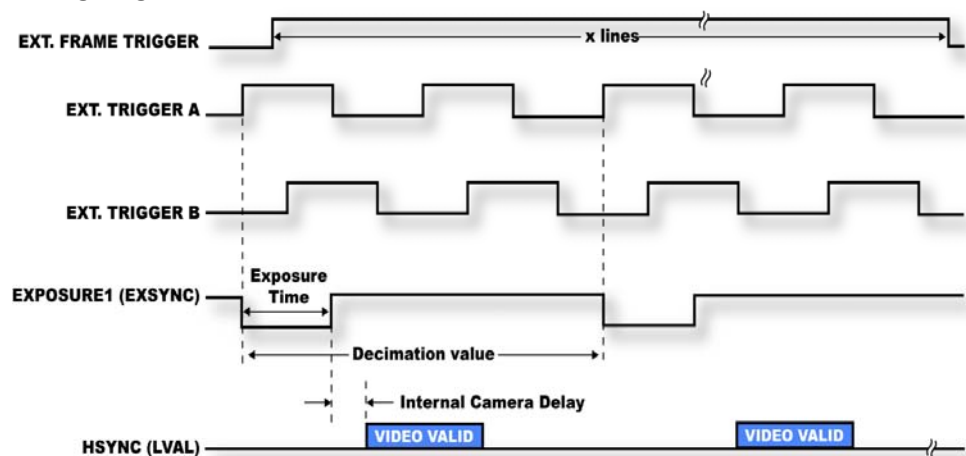
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 9: Variable line scan rate with rotary encoder and variable frame size

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF “eight 8-bit taps” mode) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Odyssey Xpro captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



x = no. of lines captured during high level

* The decimation value showed in this timing diagram is eight (8).

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Specifics about the interface modes

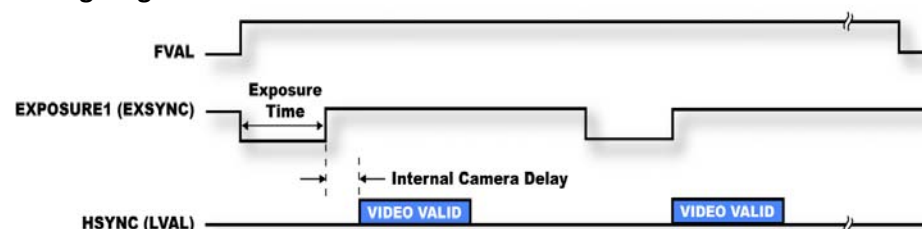
Camera Interface Details (cont.)

Mode 10: Fixed line scan rate with area (AOI) mode

- **Line/frame rate:** The line rate is fixed and controlled by the frequency of EXPOSURE1 (EXSYNC) signal. The default exposure time for the DCF (ie., "eight 8-bit taps" mode) is 14 μ s. The frame rate is fixed and controlled from the camera using the Basler Camera Configuration Tool Plus (CCT+). In this case, the number of lines per frame is determined by the value chosen in the "Output Mode \ Fval Length" section in the Basler Camera Configuration Tool Plus (CCT+). Also, this value (i.e. 1000 lines for this DCF) must match the "Image Size Y" value in the "Video Timing" tab of the DCF.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** This DCF works with all EXSYNC modes however EXSYNC, Level-controlled is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First
Exposure Time Control Mode	EXSYNC or Free Run
FVAL Length	1000

- **Bayer Color Filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



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Specifics about the interface modes

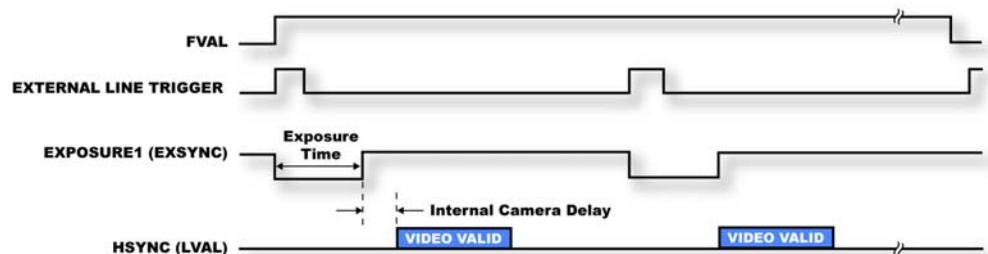
Camera Interface Details (cont.)

Mode 11: Variable line scan rate with area (AOI) mode

- **Line/frame rate:** The line rate is controlled by the frequency of the external TTL line trigger signal. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF "eight 8-bit taps" mode) or slower than the maximum line rate of the camera. The default exposure time for the DCF (i.e., "eight 8-bit taps" mode) is $14 \mu\text{s}$. The frame rate is fixed and controlled from the camera using the Basler Camera Configuration Tool Plus (CCT+). In this case, the number of lines per frame is determined by the value chosen in the "Output Mode \ Fval Length" section in the Basler Camera Configuration Tool Plus (CCT+). Also, this value (i.e. 1000 lines for this DCF) must match the "Image Size Y" value in the "Video Timing" tab in the DCF.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** This DCF works with all EXSYNC modes however EXSYNC, Level-controlled is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First
Exposure Time Control Mode	EXSYNC, Level-controlled
FVAL Length	1000

- **Bayer Color Filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



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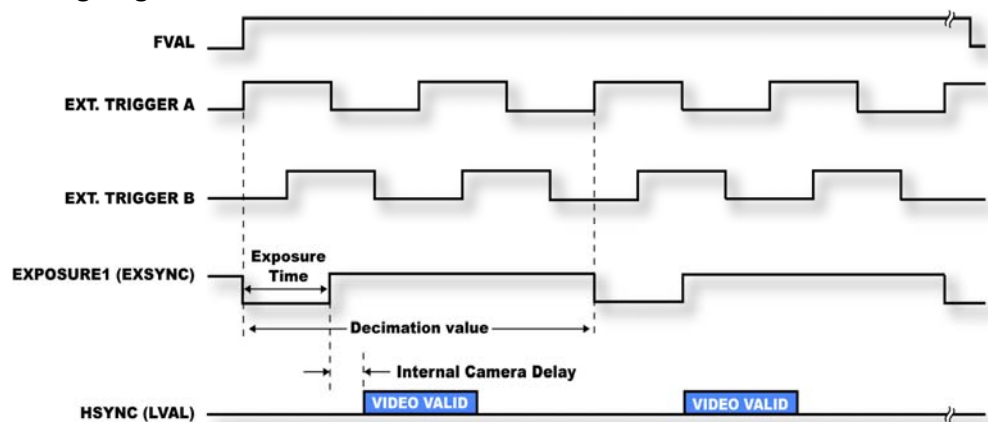
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 12: Variable line scan rate using the rotary encoder with area (AOI) mode

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera (i.e., $\approx 12.76 \mu\text{s}$ for the DCF "eight 8-bit taps" mode) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder. The frame rate is fixed and controlled from the camera using the Basler Camera Configuration Tool Plus (CCT+). In this case, the number of lines per frame is determined by the value chosen in the "Output Mode \ Fval Length" section in the Basler Camera Configuration Tool Plus (CCT+). Also, this value (i.e. 1000 lines for this DCF) must match the "Image Size Y" in the "Video Timing" tab in the DCF.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 11: Variable line scan rate with area (AOI) mode
- **Bayer Color Filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value showed in this timing diagram is eight (8).

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Cabling details for the interface modes

Cabling Requirements

Mode 1: Fixed line scan rate

- **Cable and Connection:** One Standard Camera Link cable.

Mode 2: Variable line scan rate

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

PIN NAME	PIN NO.		External Trigger Source	PIN NO.
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT)	--
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND)	--

Mode 3: Variable line scan rate with rotary encoder

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin and 44-pin connectors of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

PIN NAME	PIN NO.		External Trigger Source	PIN NO.
PO_LVDS_AUX_IN0 +	08	←	LINE TRIGGER A + (LVDS FORMAT)	--
PO_LVDS_AUX_IN0 -	03	←	LINE TRIGGER A - (LVDS FORMAT)	--

(44-pin connector)

PIN NAME	PIN NO.		External Trigger Source	PIN NO.
PO_LVDS_AUX_IN0 +	37	←	LINE TRIGGER B + (LVDS FORMAT)	--
PO_LVDS_AUX_IN0 -	23	←	LINE TRIGGER B - (LVDS FORMAT)	--

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Cabling details for the interface
modes

Cabling Requirements (cont.)

Mode 4: Fixed line scan rate with frame trigger

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External frame trigger should be connected to the OPTO TRIG input of the 9-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

External Trigger Source			
PIN NAME	PIN NO.		PIN NO.
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)

Mode 5: Variable line scan rate with frame trigger

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External frame/linetrigger should be connected to the OPTO TRIG input of the 9-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

External Trigger Source			
PIN NAME	PIN NO.		PIN NO.
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND)

Mode 6: Variable line scan rate with rotary encoder

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External frame/linetrigger should be connected to the OPTO TRIG input of the 9-pin and 44-pin connectors of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

External Trigger Source			
PIN NAME	PIN NO.		PIN NO.
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)
PO_LVDS_AUX_IN0 +	08	←	LINE TRIGGER A + (LVDS FORMAT)
PO_LVDS_AUX_IN0 -	03	←	LINE TRIGGER A - (LVDS FORMAT)

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Cabling details for the interface modes

Cabling Requirements (cont.)

Mode 6: Variable line scan rate with rotary encoder (cont.)

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 44-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(44-pin connector)

External Trigger Source			
PIN NAME	PIN NO.	PIN NAME	PIN NO.
PO_LVDS_AUX_IN0 +	37	←	LINE TRIGGER B + (LVDS FORMAT) --
PO_LVDS_AUX_IN0 -	23	←	LINE TRIGGER B - (LVDS FORMAT) --

Mode 7: Fixed line scan rate with variable frame size

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External frame trigger should be connected to the OPTO TRIG input of the 9-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

External Trigger Source			
PIN NAME	PIN NO.	PIN NAME	PIN NO.
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT) --
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND) --

Mode 8: Variable line scan rate with variable frame trigger

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External frame/line trigger should be connected to the OPTO TRIG input of the 9-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

External Trigger Source			
PIN NAME	PIN NO.	PIN NAME	PIN NO.
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT) --
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND) --
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT) --
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND) --

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Cabling details for the interface
modes

Cabling Requirements (cont.)

Mode 9: Variable line scan rate with rotary encoder and variable frame size

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External frame/line trigger should be connected to the OPTO TRIG input of the 9-pin and 44-pin connectors of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

		External Trigger Source	
PIN NAME	PIN NO.	PIN NAME	PIN NO.
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT) --
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND) --
PO_LVDS_AUX_IN0 +	08	←	LINE TRIGGER A + (LVDS FORMAT) --
PO_LVDS_AUX_IN0 -	03	←	LINE TRIGGER A - (LVDS FORMAT) --

(44-pin connector)

		External Trigger Source	
PIN NAME	PIN NO.	PIN NAME	PIN NO.
PO_LVDS_AUX_IN0 +	37	←	LINE TRIGGER B + (LVDS FORMAT) --
PO_LVDS_AUX_IN0 -	23	←	LINE TRIGGER B - (LVDS FORMAT) --

Mode 10: Fixed line scan rate with area (AOI) mode

- **Cable and Connection:** One Standard Camera Link cable.

Mode 11: Variable line scan rate with area (AOI) mode

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin connector of the External I/O adapter bracket.

EXTERNAL I/O CONNECTOR

(9-pin connector)

		External Trigger Source	
PIN NAME	PIN NO.	PIN NAME	PIN NO.
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT) --
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND) --

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Cabling details for the interface
modes

Cabling Requirements (cont.)

Mode 12: Variable line scan rate using the rotary encoder with area (AOI) mode

- **Cable and Connection:** One Standard Camera Link cable.
- **External trigger:** External line triggers should be connected to the OPTO TRIG input of the 9-pin and 44-pin connectors of the External I/O adapter bracket.

EXTERNAL AUX. I/O CONNECTOR

(15-pin connector)

		External Trigger Source	
PIN NAME	PIN NO.	PIN NAME	PIN NO.
PO_LVDS_AUX_IN0 +	08	LINE TRIGGER A + (LVDS FORMAT)	--
PO_LVDS_AUX_IN0 -	03	LINE TRIGGER A - (LVDS FORMAT)	--

(44-pin connector)

		External Trigger Source	
PIN NAME	PIN NO.	PIN NAME	PIN NO.
PO_LVDS_AUX_IN0 +	37	LINE TRIGGER B + (LVDS FORMAT)	--
PO_LVDS_AUX_IN0 -	23	LINE TRIGGER B - (LVDS FORMAT)	--

The DCFs mentioned in this application note are also attached (embedded) to this PDF file – use the Adobe Reader's View File Attachment to access the DCF files. The information furnished by Matrox Electronics System, Ltd. is believed to be accurate and reliable. Please verify all interface connections with camera documentation or manual. Contact your local sales representative or Matrox Sales office or Matrox Imaging Applications at 514-822-6061 for assistance. © Matrox Electronic Systems Ltd, 2010-2011.

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